

UNITED STATES DEPARTMENT OF AGRICULTURE

**Soil Survey**  
of  
**Woodson County, Kansas**

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Kansas Agricultural Experiment Station



**Bureau of Chemistry and Soils**

In cooperation with the  
**Kansas Agricultural Experiment Station**

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# SOIL SURVEY OF WOODSON COUNTY, KANSAS

By M. H. LAYTON, United States Department of Agriculture, in Charge, and C. E. DORN-BERGER, Kansas Agricultural Experiment Station

## COUNTY SURVEYED

Woodson County is in southeastern Kansas, in the third tier of counties north of the Kansas-Oklahoma State line and in the third tier west of the Kansas-Missouri State line (fig. 1). The boundaries form a rectangle, 21 miles wide from north to south and 24 miles long from east to west. The total area is 503 square miles, or 321,920 acres. Yates Center, the county seat, is about 150 miles southwest of Kansas City and about 100 miles east of Wichita.

Woodson County is part of a plain having undulating or rolling surface relief. The most rolling relief is in the southwestern part, extending from a point a few miles north of Toronto southward to the southwestern corner and eastward along the county line to the Missouri Pacific Railroad. A narrow belt, less rolling than this extends north-eastward from the central part of the southwestern area to the northern county line about 8 miles west of Neosho Falls. Most of the northwestern part of the county is rolling, but less so than the southwestern part. A small area in the extreme southeastern part is also rolling. A belt having very low relief extends southwestward from the northeastern part of the county to the latitude of Yates Center and thence southward to the county line. Another area of similar relief occupies the central-western part.

The underlying rocks consist dominantly of shales and sandstones. The geological section includes two horizons of thin-bedded limestones, one outcropping in the rolling area of the southeastern part of the county, the other in a belt extending from the vicinity of Toronto northeastward to the northern county line, about 10 miles northwest of Neosho Falls. The rocks are all of late Paleozoic age, and they dip at a very low angle to the northwest. The rolling area in the southwestern part of the county is underlain by sandstones, but the smooth land in this section is underlain by a resistant limestone bed which lies geologically immediately above the sandstone.

The range of elevation is not great. Yates Center, on the divide between Neosho and Verdigris River systems, is 1,112 feet above sea level;<sup>1</sup> Toronto, in the southwestern part of the county, has an elevation of 928 feet; and Neosho Falls, in the northeastern part, 976 feet.

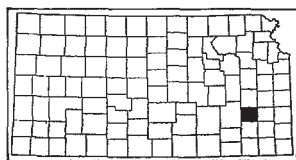


FIGURE 1.—Sketch map showing location of Woodson County, Kans.

<sup>1</sup> GANNETT, H. A DICTIONARY OF ALTITUDES IN THE UNITED STATES. U.S. Geol. Survey Bull. 274, Ed. 4, 1,072 pp. 1906.

The drainage flows in a general southeasterly direction and is effected through numerous small streams radiating from the central divide. These streams are sluggish and have meandering channels with a gradient of less than 3 feet a mile, except near the heads of some of the smaller streams where the gradient is greater. All the drainage is effected through Neosho and Verdigris Rivers and their tributaries. The rivers flow continuously throughout the year, but their tributaries flow intermittently during the summer.

The natural vegetation on the uplands consists almost entirely of grasses, two of the most abundant of which are bluestem and broom-sedge. A number of wild legumes, such as prairieclover, hoary pea or catgut, and *Psoralea tenuiflora*, grow on the prairie lands. In some pastures many kinds of weeds have come in as a result of overgrazing. On the steeper slopes, shrubs and vines, such as butter-nut, wood vine, dogwood, sumac, bittersweet, wild grape, blackberry, wild cherry, and persimmon, grow. The well-drained alluvial land was originally covered with trees, and the wet land with marsh grasses. The trees consisted chiefly of hackberry, elm, ash, pin oak, black walnut, cottonwood, locust, almond, willow, sycamore, and black oak. In the southwestern part of the county, small areas of the stony upland are covered with a growth of post oak, black oak, maple, and a few other trees, such as papaw and hawthorn.

On slopes where erosion has removed the soil material down to the partly decomposed sandstone and shale, needlegrass has come in to some extent, and in places a few square feet are nearly bare of vegetation. Under prairie vegetation the uneroded soil contains a very good supply of organic matter as the result of the favorable conditions for the accumulation and preservation of humus, but on the imperfectly drained soils the vegetation is not so vigorous and the organic matter is seemingly not so abundant as on the well-drained soils.

Woodson County was originally part of the New York and Osage Indian Reservation. In 1860 the Government opened the reservation to purchase and preemption at the land office in Fort Scott. Many squatters had been living on the reservation for many years, some of them having entered as early as 1855.

Settlement was slow at first, but soon after the Civil War settlers came in rapidly. The population in 1930 was 8,526, all of whom were classed as rural, with a density of 16.9 persons to the square mile. Many of the early settlers came from Europe, mainly from Germany, and others came from Ohio, Missouri, Kentucky, Tennessee, and Illinois. Yates Center, the county seat, has a population of 2,013. Smaller towns are Toronto, Neosho Falls, Piqua, Rose, and Vernon. Iola, a city with a population of 7,160, lies just a few miles east of Woodson County, in Allen County.

The county is well supplied with railroad facilities, as it has about 85 miles of main-line railroads extending through it, with numerous side tracks. The railways serving the county are the Atchison, Topeka & Santa Fe; the Missouri Pacific; and the Missouri, Kansas & Texas. Most of the farms are within a short distance of shipping points, and hay, grain, and livestock can be shipped without long local hauls.

The State and Federal highways are graveled and well maintained. Motor bus lines cross the county in several directions, and transportation facilities are good. On the upland, travel is seldom hindered by bad roads, but on the alluvial lands the dirt roads are frequently in bad condition. Most roads follow section lines.

Telephone service and rural mail routes reach all sections. The first school was opened in the summer of 1858 at Neosho Falls. More than 60 county district schools are now in operation, each town having at least one good school. Churches are well distributed.

The main industries are farming, livestock raising, and oil production. Much hay and other surplus farm products, including grain, livestock, dairy products, and poultry products, are marketed outside the county. The greater part of the grain is handled through local elevators or is fed on the farm, and the hay is baled and shipped from the numerous local shipping points. Livestock raising is of considerable importance, owing to the adequate supply of hay and pasture. The oil industry is confined principally to the northwestern part of the county where several small producing fields are located.

### CLIMATE

The climate is continental and is characterized by wide seasonal variations. It has an unusual combination of sunshine and rainfall, about two-thirds of the rain falling during the growing season, from April to October, inclusive. The summer rains generally come in the form of thunderstorms of short duration, but most of the winter rains are slow and drizzling. The winters are usually mild. During some winters the temperature does not fall below zero, but even during extremely cold spells the temperature usually does not remain below zero for more than a day or two. Blizzards are uncommon and are in general of short duration. In summer, the weather becomes very warm, especially during times of drought, and temperatures of 100° F. or higher are common, but such spells are ordinarily of short duration.

Total crop failures are very rare. Yields of corn, however, in an amount equal to the full capacity of the soil alone, are probably almost as rare. Although yields of corn as a rule are somewhat less than could be produced if the moisture supply were adequate throughout the season, serious droughts, accompanied by hot winds, either in July or August, may not be expected with destructive effect more often than once in a decade. The strongest winds occur during the last part of March and the first part of April. The wind velocity during the 24-hour period ranges between rather wide limits, increasing during the warmest part of the day and falling at night. The most damaging winds are the hot winds occurring during periods of dry weather and often reaching a high velocity.

The average date of the last killing frost is April 18 and of the earliest is October 18, giving an average frost-free season of 183 days. Frost has been recorded as late as May 15 and as early as September 26.

Table 1 gives the more important climatic data for Woodson County. It is compiled from records of the United States Weather Bureau station at Toronto in the southwestern and most densely wooded section, along the Verdigris River Valley.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Toronto, Woodson County, Kans.*

[Elevation, 1,040 feet]

Month	Temperature, mean	Precipitation		
		Mean	Total amount for the driest year (1917)	Total amount for the wettest year (1927)
	° F.	Inches	Inches	Inches
December.....	33.8	1.33	0.64	1.55
January.....	31.2	1.43	.92	.64
February.....	34.6	1.61	( <sup>1</sup> )	.29
Winter.....	33.2	4.37	1.56	2.48
March.....	45.5	2.16	3.45	3.91
April.....	56.0	3.97	3.08	13.05
May.....	65.1	4.79	4.87	2.76
Spring.....	55.5	10.92	11.40	19.72
June.....	74.1	4.84	.80	9.09
July.....	78.8	4.02	1.15	4.81
August.....	78.8	3.41	4.79	10.05
Summer.....	77.2	12.27	6.74	23.95
September.....	71.2	4.39	2.55	3.95
October.....	59.1	3.11	.25	5.29
November.....	46.0	2.01	( <sup>1</sup> )	.73
Fall.....	58.8	9.51	2.80	9.97
Year.....	56.2	37.07	22.50	56.12

<sup>1</sup> Trace.

## AGRICULTURAL HISTORY AND STATISTICS

The early settlers in the section now included in Woodson County found a prairie covered with a heavy growth of grass and broken only by narrow wooded valleys along the larger streams. The valleys furnished the natural locations for homes, owing to the proximity of water and wood. The earliest important industry was cattle raising. A few acres of bottom land were planted to corn, but the cattle were raised and fattened largely on the native grasses. In the early days many cattle were brought in from Indian Territory (now Oklahoma) and Texas, but as the range land was taken up by the settlers, the numbers of cattle brought in from the south gradually decreased, and diversified farming and cattle raising on a smaller scale were practiced. Agriculture has developed around some form of livestock industry. Corn and garden crops for home use were the first crops grown by the pioneers, and these were followed later by the production of small quantities of such crops as wheat, oats, rye, and flax. Later the raising of poultry, hogs, and sheep and the introduction of legumes and kafir have been important in furthering a greater diversity of agricultural practices.

As a whole, the agriculture may be said to consist of general farming, with some cash grain crop, but corn has been the most important cultivated crop and cattle raising the most important livestock industry since early settlement. Figure 2 shows the acreages devoted to the three principal grain crops through a series of years. For

many years after settlement corn was the principal crop, partly because of the necessity for a feed-grain crop, due to the importance of livestock in the farming system. As the range lands were converted into crop land, and as the adaptabilities of the soils were better understood, the corn acreage decreased and that of the small grains and grain sorghums increased.

Kafir is becoming an important crop in this part of the State and has attained a position close to that of corn, which it is largely displacing on many farms. This is because of the superior drought-

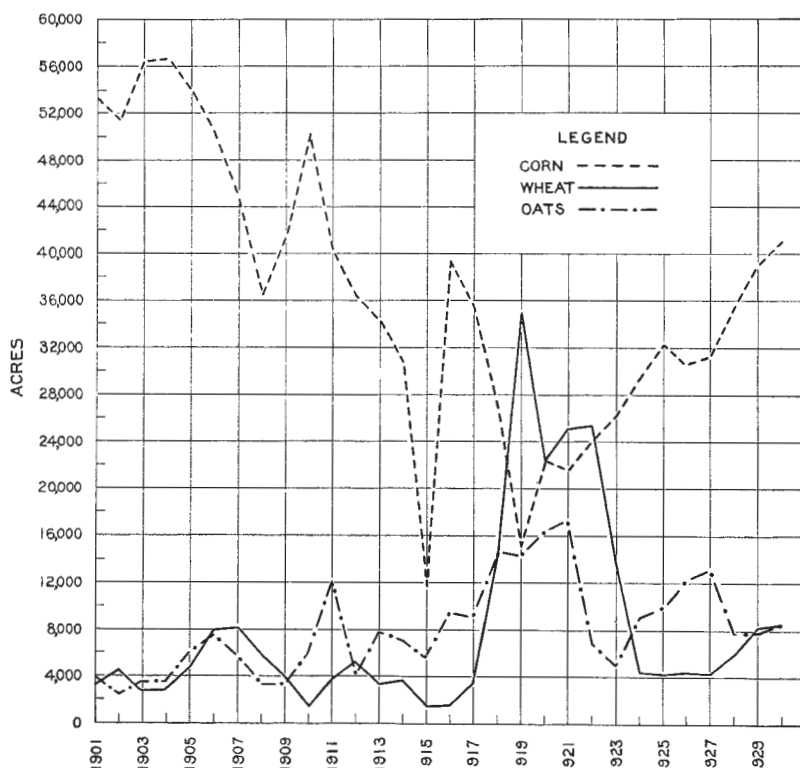


FIGURE 2.—Acreages devoted to corn, wheat, and oats in Woodson County, Kans., from 1901 to 1930.

resistant qualities of kafir and the consequent greater certainty of the crop. In 1919 kafir was grown on 5,525 acres, with an average acre yield of 15.4 bushels, and in 1929 sorghums for grain (most of which was kafir) were grown on 9,863 acres with an average acre yield of 12.1 bushels.

Wheat was grown on 2,992 acres in 1879 and produced an average acre yield of 13.1 bushels, and in 1929 it was grown on 8,838 acres and produced an average acre yield of 10.9 bushels. As shown in figure 2, wheat production was greatly increased during the World War. Wheat receives the greater part of the fertilizer used.

Oats, like wheat, have increased slightly in acreage; and the acre yields have remained about the same, slightly more than 15 bushels.

Other crops, such as rye, barley, and flax, have been grown to some extent by a few farmers, but they are of comparatively little importance.

Among the crops produced in this county, wild hay occupies the largest acreage. In 1929 wild grasses from 53,365 acres were cut for hay, and the yield was 54,811 tons. The acre yields of hay have remained very uniform. Overgrazing and a consequent reduction in the quality of the natural vegetation has reduced the carrying capacity of many pastures about one-third.

Alfalfa and other legumes are grown in some sections. In 1929, 2,977 acres were in alfalfa and 382 acres in clover and timothy mixed, which produced, respectively, 5,559 tons of alfalfa hay and 469 tons of mixed hay. Sorgo for sirup, buckwheat, tobacco, broom-corn, and beans were at one time minor crops, but at present little or no acreage is given to these crops.

Data taken from the reports of the Kansas State Board of Agriculture giving 10-year averages of the acreage and yield of wheat, corn, oats, and alfalfa, are set forth in table 2.

TABLE 2.—Average acreage and yield of the principal crops in Woodson County, Kans., by 10-year periods<sup>1</sup>

Crop	1901-10		1911-20		1921-30	
	Average acreage	Average yield	Average acreage	Average yield	Average acreage	Average yield
Wheat.....	<i>Acres</i> 4, 638	<i>Bushels</i> 70, 097	<i>Acres</i> 9, 427	<i>Bushels</i> 159, 359	<i>Acres</i> 10, 515	<i>Bushels</i> 123, 371
Corn.....	49, 652	915, 278	29, 394	461, 440	31, 147	581, 402
Oats.....	4, 538	99, 875	10, 192	250, 773	9, 811	196, 571
Alfalfa.....	1, 519	<i>Tons</i> 4, 557	3, 205	<i>Tons</i> 9, 615	3, 643	<i>Tons</i> 9, 416

<sup>1</sup> Kans. State Bd. Agr. Bien. Rept. 27, 1931.

The 1930 census gives the value of crops produced in 1929 and of livestock and livestock products, as set forth in table 3.

Product	Value	Livestock and products	Value
Cereals.....	\$559, 844	Domestic animals.....	\$1,515,874
Other grains and seeds.....	6, 358	Butter, cream, and whole milk sold.....	181, 929
Hay and forage.....	455, 614	Poultry raised.....	217, 034
Vegetables (including potatoes and sweet-potatoes).....	24, 075	Chicken eggs produced.....	344, 235
Fruits and nuts.....	20, 294	Wool shorn.....	6, 942
All other field crops.....	185	Bees.....	1, 987
Farm garden vegetables for home use.....	39, 258	Honey.....	1, 484
Total.....	1, 105, 623	Total.....	2, 269, 485
		Total agricultural products.....	3, 375, 113

Both potatoes and sweetpotatoes are grown, mainly in small quantities for home use. Most farmers have had small home gardens since early times. Sufficient fruits and vegetables are produced for home use during most years, but no commercial production is reported. Many farmers devote small patches to melons, strawberries, blackberries, and raspberries, and a few have small vineyards.

A number of small orchards are in the county, mainly of apple and peach trees, with some pear, plum, and cherry trees.

Poultry and eggs are produced in a small way on nearly every farm.

The work animals consist of horses and mules of light or medium weight. The United States census of 1930 reported 4,660 horses and 1,130 mules in the county, on April 1 of that year. Only a few sheep are raised, but in recent years the number has increased more than that of any other kind of livestock.

Commercial fertilizers are not used to a great extent. They are used almost exclusively on the upland soils for wheat and legumes. The 1930 census reports an expenditure of \$9,880 for fertilizer on 182 farms in 1929, an average of \$54.28 a farm reporting. The fertilizers are bought ready mixed and are high in phosphates. Ground limestone is used extensively by some farmers for clover and alfalfa.

Farm labor is generally plentiful. Monthly wages differ greatly from year to year, ranging from \$25 to \$40 a month with board. Day labor is paid from 50 cents to \$2.50 depending on skill and the demand. In 1930, \$137,031 was expended for labor on 497 farms, an average of \$275.92 a farm reporting.

In 1930, 41.1 percent of the farms were operated by tenants, 0.2 percent by managers, and 58.7 percent by owners. Farms range in size from 40 acres to several sections, with an average of about 160 acres. Most of the rented farms are leased on a crop-share plan.

The farmhouses are, as a rule, substantial and fairly well constructed. Most of the barns are large enough to house the work animals and store the various crops, and most fields are well fenced. Grain drills, harvesters, tractors, mowers, rakes, cultivators, disks, hay presses, and plows are used where there is sufficient acreage in crops requiring such machinery. The 1930 census reports 1,110 automobiles, 172 motor trucks, 259 tractors, 20 electric motors for farm work, and 313 stationary gas engines on farms. In that year, telephones were on 759 farms, 92 farms had water piped to the dwelling house, and 67 farm homes were lighted by electricity.

### SOILS AND CROPS

Woodson County lies in the prairie plains section of southeastern Kansas. The underlying rock formations consist of limestone, sandstone, and shales, and several distinct soil types have been produced from the products caused by weathering of these rocks. The shale formations, from which the greater part of the soils has been developed, contain gypsum. As the climate is practically the same over the entire county, soil differences must be due to differences in the character of the underlying material, to differences in surface relief, and to differences in natural vegetation.

Somewhat more than 60 percent of the land area of Woodson County is tillable, and the rest consists of rough stony land and stream bottoms, part of which is used as pasture. The tillable land is topographically well suited to farming and allows the use of labor-saving machinery. Throughout the county small areas of woodland contain hickory, walnut, elm, oak, and Osage-orange trees.

The agriculture of Woodson County differs from that of the rest of southeastern Kansas, in that the production of hay and cattle raising are of more importance than the production of cultivated crops. It is, and has been for many years, a self-sufficing type of agriculture. Most of the farms are large, and the greater part of the farming operations are accomplished with work animals, although a few tractors are used. It has been the purpose of the farmers to produce sufficient food and feed to supply the home and in addition to grow enough hay and raise some livestock, in order to obtain needed cash. Considerable income has been derived from time to time from the sale of livestock, poultry, and dairy products.

Corn, wheat, oats, grain sorghums, and hay are produced as general farm crops. Alfalfa, clover, and soybeans are becoming more common, and their beneficial effects are more noticeable. Fruits and vegetables are produced for local use only but not in large enough quantities to supply the local demand. Although corn, wheat, oats, and kafir are grown on all the soils, regardless of soil character, differences in yields (where all other conditions than soil character are uniform) give striking expression to differences in inherent productivity and adaptability.

Hay is the principal crop, and it is grown principally on the claypan soils—Parsons and Woodson. This crop is produced both for feed on the farm and as a cash crop, much of which is shipped to distant markets. Corn is grown on nearly all farms, but the largest yields are produced on soils with friable subsoils. This crop is produced principally as feed for livestock and poultry. Wheat is grown mainly on the claypan soils, and most of it is sold as a cash crop to local elevators. Oats are grown chiefly in a rotation between corn and wheat. Oat yields average higher than those of corn or wheat, and this crop is grown when farmers need extra feed.

Alfalfa, sweetclover, red clover, Korean lespedeza, and soybeans are increasing in importance. In many pastures, Korean lespedeza and alsike clover are replacing useless weeds.

In order to bring out the relation existing between the different soils and the agriculture of the county, the soils are divided into five groups, representatives of which occur on many farms. The soil types in each of these groups have the same general characteristics and somewhat similar crop adaptations. These five groups are as follows: (1) The Parsons group, including Cherokee silt loam, Parsons silt loam, and Woodson silt loam; (2) the Summit group, including Summit silty clay loam and Summit stony silty clay; (3) the Labette group, including Labette silt loam, Labette silt loam, cherty phase, Labette silt loam, gravelly phase, Labette silt loam, heavy-subsoil phase, Crawford silt loam, and Crawford stony silt loam; (4) the Bates group, including Bates very fine sandy loam, Bates loam, Bates fine sandy loam, shallow phase, and Bates stony loam; and (5) the Verdigris group, including Verdigris silt loam, Verdigris very fine sandy loam, Verdigris silty clay loam, Lightning silty clay loam, Lightning very fine sandy loam, Osage silty clay loam, and Osage clay.

Group 1 occupies 40.9 percent of the county; group 2, 11.4 percent; group 3, 7.7 percent; group 4, 30.7 percent; and group 5, 9.3 percent.

The soils of the Parsons group occupy more than half the county and occur in large continuous areas in all except the southwestern part, where only a few small bodies occur. The soils of the Summit group are not well represented in any one place but are scattered in small areas over the county. The soils of the Labette group are similar in character to those of the Summit group and occur in the same sections. The soils of the Bates group lie mainly south of the major divide, along the south slope of the watershed. The soils of the Verdigris group are mainly developed along Neosho and Verdigris Rivers and their larger tributaries. The soils in each group dominate the agriculture in their particular section.

In the following pages, the soils of Woodson County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Woodson County, Kans.*

Type of soil	Acre	Percent	Type of soil	Acre	Percent
Cherokee silt loam.....	512	0.2	Bates loam.....	768	0.2
Woodson silt loam.....	36,928	11.5	Bates very fine sandy loam.....	27,904	8.7
Parsons silt loam.....	94,016	29.2	Bates fine sandy loam, shallow phase.....	26,112	8.1
Summit silty clay loam.....	29,888	9.3	Bates stony loam.....	44,032	13.7
Summit stony silty clay.....	6,784	2.1	Verdigris very fine sandy loam.....	4,800	1.5
Labette silt loam.....	21,248	6.6	Verdigris silt loam.....	10,432	3.2
Labette silt loam, gravelly phase.....	1,088	.3	Verdigris silty clay loam.....	1,856	.6
Labette silt loam, cherty phase.....	256	.1	Osage silty clay loam.....	5,504	1.7
Labette silt loam, heavy-subsoil phase.....	448	.1	Osage clay.....	1,984	.6
Crawford silt loam.....	1,024	.3	Lightning silty clay loam.....	5,120	1.6
Crawford stony silt loam.....	960	.3	Lightning very fine sandy loam.....	256	.1
			Total.....	321,920	

#### SOILS OF THE PARSONS GROUP

The soils of the Parsons group have grayish-brown or dark-gray surface soils underlain by heavy dense claypans. They are devoted to a special type of farming and to special crops, such as hay, wheat, flax, and kafir. Because of the heavy claypan underlying the comparatively shallow surface soils, plants develop shallow root systems. The moisture supply available to such plants necessarily lies in the rather thin surface soil, very little being derived from the heavy clay subsoil. The amount present differs greatly, depending on the frequency of rains and the rate of loss from evaporation. These soils require, for their most favorable production, frequent light rains, as heavy rains saturate the thin surface soil, making it too wet for crops. During periods of low rainfall and high temperature, crops suffer from lack of moisture. The dominant crops grown are those which mature before the period of infrequent rains and high temperatures of midsummer arrives.

The soils of this group have smooth or gently undulating surface relief and are lighter in color than those of the Summit and Labette groups. Natural surface drainage ranges from fair to good, but internal drainage is slow, as the dense claypan subsoil is unfavorable to the movement of moisture. Sheet erosion is somewhat active on

the greater part of the land under cultivation but is most noticeable along streamways.

The surface soils are dominantly silt loams, ranging in color from light grayish brown to very dark brown, and they have a soft, smooth, silty feel. The subsoils are dominantly heavy claypans, drab or reddish brown in color, with some red and rust-colored mottlings. They are plastic and waxy when wet and very hard when dry. The subsoils contain enough soluble salts to cause some efflorescence on outcrops in dry weather. No laboratory determinations of the composition of these salts has been made, but field tests with ammonium oxalate and barium chloride indicate the presence of gypsum crystals in the shales, and their argillaceous decomposition products show that they are gypsum. They are not toxic to plants to a noticeable extent. The low productivity of these soils is due mainly to their poor physical character. In all soils of this group the parent shale material lies from 40 to 70 inches below the surface. These soils are low in organic matter. They range from slightly to medium acid. The heavy clay subsoil is too dense for ready penetration by plant roots, and such penetration as does take place is mainly along cracks.

Optimum moisture conditions endure for only a short time. When the soil is very wet, the plants feed only at the surface, as the deeper roots die, and when it is very dry the roots cannot penetrate to a great depth, as the clay expands and contracts, thereby breaking the roots and exposing them to the dry air causing them to die. Good tilth is hard to obtain. Heavy spring rains cause the soils to puddle, and in many places water stands on the surface until it evaporates, leaving the crops in poor condition to withstand dry weather.

Only shallow-rooted plants with wide-spreading root systems, such as the grain sorghums, wheat, meadow fescue, flax, and timothy, succeed even moderately well on these soils. The grain sorghums do fairly well, as they remain dormant in dry periods and mature later, when the season may be more favorable. Corn cannot withstand the adverse moisture conditions so well as the grain sorghums and is therefore an uncertain crop. The grain sorghums yield a little more than corn, and the crop is more certain. Blackhull and Red kafir are grain sorghums especially suited to soils of this group. Atlas and Kansas Orange are the best sorghums for silage, hay, and bundle-feed purposes. Fulcaster and Kanvale are the highest yielding varieties of wheat. Such legumes as cowpeas, soybeans, red clover, and sweetclover are grown. The varieties of soybeans that do well on these soils are A.K., Peking (Sable), and Laredo. These are grown for hay, grain, and as green-manure crops. Flax is grown to some extent, and Linota is the best adapted variety.

The light-colored claypan soils are more uniform in their surface features than the darker colored soils, and this characteristic allows seed crops to mature more uniformly and simplifies harvesting. The soils of this group produce comparatively low crop yields, with the exception of the native grasses, owing to low fertility and lack of drought resistance, the latter being of much more importance, because droughts, often accompanied by hot winds, occur.

Experiments have shown that grain sorghums will give higher yields on the soils of this group year after year than will corn, but considerable acreages of corn are planted, mainly because corn is

the dominant grain crop in the humid prairie region, the region of dominant grain sorghums lying more than a hundred miles farther west. The average acre yield of corn on these soils is about 20 bushels, of wheat 15 bushels, of kafir 30 bushels, and of tame hay about 1 ton.

**Cherokee silt loam.**—Cherokee silt loam, or the so-called “ashy land”, has developed in a few practically level spots. The soil profile, or the succession of layers in the soil, from the surface downward, is very striking. The surface soil, to a depth of about 5 inches, is grayish brown or dark gray. It is underlain by very light colored porous silty material to a depth ranging from 10 to 15 inches. In plowing, some of the gray material is turned up to the surface, giving the soil in plowed fields a well-defined gray color, hence the popular designation, “ashy land”. In addition to the gray color of this material, it contains a large number of small brown or rust-colored iron hydroxide concretions. The gray layer is underlain abruptly by tough heavy clay forming a well-defined claypan. It is brown, faintly reddish brown, or drab and contains spots and streaks of gray, yellow, and rust-colored materials. This layer ranges in thickness from less than a foot to somewhat more than a foot, and it is underlain by rather massive mottled clay which is somewhat less heavy and tough than that of the claypan. This layer, in turn, overlies shales of Carboniferous age. The claypan layer breaks on exposure into angular particles with a maximum size of about 1 inch in diameter, many of which are cubical. Most of the particles are coated, especially in the upper part of the horizon, with a brown or dark-brown glistening coating. The claypan changes gradually downward to material of lighter color and texture and, at a depth of about 40 inches, changes to yellowish-gray shaly silty clay. Partly weathered shale and sandstone, from which the Cherokee soil material is derived, in most places occur at a depth ranging from 5 to 6 feet. In plowed fields the surface soil is almost ash gray when dry, but it is almost black when wet. Its pH value ranges from 4.5 to 5.

Crop yields on this soil are a little less than on the other members of the Parsons group.

Only a few small areas of this soil were identified. A few lie near Lomando northeast of Yates Center, and two small areas are southwest of Neosho Falls.

**Woodson silt loam.**—The surface soil of Woodson silt loam is very dark grayish brown or almost black to a depth ranging from 7 to 12 inches. The texture is silt loam, somewhat finer in grain than the surface layer and gray layer in Cherokee silt loam. This layer is underlain abruptly, at a depth of about 10 inches, by very dark drab, dark grayish-brown, or black heavy clay. The color is nearly uniform throughout, and the breakage on exposure is much like the claypan layer of Cherokee silt loam. This layer has a maximum thickness of nearly 20 inches, and it merges gradually into olive-green or yellow clay which contains various quantities of gypsum, both in powdered and crystal form, and lime concretions are present in many places. Below a depth ranging from 40 to 50 inches, the subsoil is underlain by soft decomposed gypsiferous shales.

The surface soil contains a fair supply of organic matter and is rather dark when dry and almost black when wet. The pH value of the surface soil in plowed fields ranges from 5.5 to 6.5.

Yields, especially of corn, are a little higher on this soil than on the other members of the Parsons group.

The largest body of Woodson silt loam lies on the smooth upland several miles northwest of Yates Center. Many small areas are in the southwestern part of the county, in the northwestern part, and a few in the extreme southeastern part.

Table 5 gives the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Woodson silt loam.

TABLE 5.—*Mechanical analyses of Woodson silt loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
382704	Surface soil, 0 to 7 inches.....	0.1	0.4	0.6	4.5	6.9	57.4	30.0
382705	Subsurface soil, 7 to 14 inches.....	.1	.2	.2	1.7	2.6	36.7	58.4
382706	Subsoil, 14 to 30 inches.....	.5	.3	.3	.6	.9	42.9	54.6
382707	Subsoil, 30 to 36 inches.....	.4	.4	.4	1.3	2.3	44.7	50.6
382708	Subsoil, 36 to 44 inches.....	.9	2.2	1.2	3.5	6.3	48.2	37.7

**Parsons silt loam.**—Parsons silt loam, the most widely distributed member of the Parsons, or claypan, group in Woodson County, is, in characteristics, intermediate between Cherokee silt loam and Woodson silt loam. The surface soil is dark brown, darker than the surface soil of Cherokee silt loam, and it is less dark than that of Woodson silt loam. The dark-colored layer has a maximum thickness of about 8 inches and is underlain by brown silt loam, a few inches thick, and this, in turn, by a heavy dark-colored rather faintly mottled claypan containing more organic matter and extending to a greater depth than the corresponding layer in the Cherokee soils. Owing to the greater content of organic matter in the claypan, the roots of plants penetrate it more easily than they do the corresponding layer of Cherokee silt loam.

Surface drainage is better than in the Cherokee soil, and erosion has exposed the claypan in more places on the slopes. In general, the physical condition is a little better, as the subsoil is not uniformly so dense, and plants can feed to some extent in it. Corn produces better yields than on Cherokee silt loam but less than on Woodson silt loam. Soybeans and cowpeas do fairly well, and corn following these legumes does better than the average.

#### SOILS OF THE SUMMIT GROUP

The surface soils of the Summit group are dark grayish brown or black, and the subsoils are dark drab. The change between the surface soil and subsoil is not abrupt, but the whole solum is rather heavy. The members of this group do not cover a large total area in Woodson County, and in general they occur in small areas. Most of them are in the west-central part of the county. They are commonly called "black gumbo" or "clay land."

Productivity is higher than on the lighter colored soils of either the Parsons or Bates groups. The soils of the Summit group show less marked response to the applications of fertilizer than the lighter colored claypan soils. The reaction of the surface soils of members of the Summit group is almost neutral, whereas that of the light-colored soils is acid.

The organic matter is so intermixed with the mineral constituents that it is an integral part of the soil. It imparts the soft crumb structure so desirable for tillage and is highly conducive to the maintenance of good moisture conditions, thus allowing a large feeding range for plant roots. It is also the chief source of nitrogen, which is highly beneficial to successful plant growth. The physical condition of these soils is generally good, enabling crops to survive periods of dry weather and to recover rapidly from the effects of heavy rains.

In a few places erosion has removed much of the surface organic matter, the resultant soil having a tendency to bake, puddle, and crack. In long-cultivated fields, soils of this group crack and allow great quantities of the surface soil to fall into the subsoil. This gives the soil an uneven textural appearance, the surface soil tending to become heavier. This form of erosion is noticed only where organic matter is depleted. In virgin fields the heavy texture of the surface soil causes the soil to crack to different depths during extremely dry periods.

The crops grown on the soils of this group include a larger proportion of corn and alfalfa than is grown on the lighter colored and claypan soils. Clover and lespedeza do well on the stony areas, and pastures are good on all areas, but wheat, flax, and kafir are not grown to a great extent.

**Summit silty clay loam.**—Summit silty clay loam is the most extensive soil of the Summit group. The surface soil is nearly black silty clay loam becoming somewhat lighter in color and a little heavier at a depth ranging from 10 to 20 inches. The structure of the dark-colored layer is highly granular, presenting the appearance, where conditions are most favorable and the structure has not suffered from cultivation, of a mass of black fish eggs. The subsoil is dull-drab or dark-brown, with spots of gray and yellow, heavy clay loam, somewhat heavier than the surface soil. It breaks into angular particles which crush easily when moist but are intractable when dry. The particles are coated with dark material, but the thickness of the coating decreases downward and finally disappears at a depth between 3 and 4 feet. The interior of a crushed particle is lighter in color than the outside. This layer gradually passes into yellowish-gray clay.

Summit silty clay loam has been developed from materials accumulated by the decomposition of calcareous and gypsiferous shales and thin-bedded limestones. Rocks of this kind outcrop, mainly in the southwestern quarter, the northwestern quarter, and the southeastern corner of the county, and this soil is almost entirely confined to these sections. It occurs in small bodies, few of which cover more than a few hundred acres.

About 95 percent of the area of this soil is in cultivation, mainly to corn, although many other crops do well. The high content of

organic matter and the fine texture cause the soil to be somewhat too moist for wheat production and for easy cultivation in early spring. Some plants growing on it have a pale-green color, owing to too much moisture and lack of nitrification. The best adapted varieties of corn are Midland Yellow Dent and Commercial White. They mature about 1 week later than most varieties, but the yield is higher.

**Summit stony silty clay.**—Summit stony silty clay is similar in its upper layers to Summit silty clay loam, except for the presence of scattered fragments of limestone on the surface and at different depths in the solum. This soil is used principally as pasture. Clover seems to do fairly well when the land is not too dry, and many pastures are producing small amounts of clover.

#### SOILS OF THE LABETTE GROUP

The soils of the Labette group occur mainly in isolated areas extending northeastward from Toronto and southward from Piqua along the eastern part of the county, and a few areas are mapped in other parts.

The soils of this group have dark reddish-brown or dark grayish-brown surface soils and moderately friable brown or reddish-brown subsoils. These soils are used mainly for the production of corn, wheat, and kafir. They are droughty in dry years but produce well in years of abundant moisture. They are inherently fertile, containing good supplies of the plant nutrients, are neutral or very slightly acid in reaction, and are free from claypans. In years of good moisture supply they are the most productive soils in the county, but in dry weather crops suffer. These soils are loose and porous and are referred to by many farmers as "push soils."

The soils of this group have smooth or gently undulating surface relief and are dominantly silt loams. Natural surface drainage ranges from fair to good, and internal drainage ranges from good to excessive in the lighter red soils and is fair in the darker soils. The structure of the subsoil is very favorable for aeration, oxidation, and movement of moisture. Ferruginous pellets are common in all these soils. The limestone rocks, from which the parent material was derived through decomposition, lie a little nearer the surface than do the rocks underlying any other soils in the county, except certain members of the Bates group. It lies at a depth ranging from 20 to 40 inches.

The cultivated soils are lower in organic-matter content and are lighter in color than the uncultivated soils. The good drainage makes them favorable for early growing crops, as optimum moisture is better obtained in early spring. Droughts are noticeable first on the soils of this group, and early maturing crops are more essential on these soils than on the soils of any other group. Leguminous crops, such as clover and alfalfa, are grown to some extent, with the addition of lime. The surface soils are not uniform in their organic content, and crops do not mature so uniformly as on other soils. This feature makes the growing of wheat undesirable, as part of the crop is ready for harvest before the other part has matured.

**Labette silt loam.**—Labette silt loam has developed from calcareous shales containing gypsum and from limestones. It is the most

extensive soil of the group. The profile characteristics are not uniform. The surface soil, to a depth of about 8 inches, is dark grayish-brown silt loam, the darkness of color varying with the amount of organic matter present. The lower part of the surface layer is faint reddish brown and contains numerous ferruginous pellets, or concretions. In plowed fields the soil is reddish brown when dry and almost black when wet. There is no distinct line of demarcation between the surface soil and subsoil, but the subsoil begins at a depth of about 14 inches. It is dark reddish brown, mottled and spotted with gray, yellow, and rust-brown stains, and it becomes lighter in color with increasing depth, the gray and yellow colors increasing and the dark organic stains becoming fewer.

The surface soil is granular in structure like the Summit soils. The subsoil breaks into small angular particles, smaller than those of the Summit soils, each particle being coated with a dark-colored material in the upper part and browner in the lower part. The insides of the structure particles are reddish brown. The underlying limestone or highly calcareous shale is reached, in most places, at a depth ranging from 3 to 5 feet. Labette silt loam is the most productive member of the Labette group.

**Labette silt loam, gravelly phase.**—Labette silt loam, gravelly phase, has little agricultural value. It occurs on hilltops and slopes and is the chief source of gravel used in surfacing highways. It is similar in its surface features to typical Labette silt loam but contains various quantities of water-worn gravel of unknown origin. The presence of the gravel makes the land droughty and less productive than typical Labette silt loam. This soil occurs in small patches which are seldom, if ever, farmed separately. It occurs in some pastures and has a tendency to increase the value of the land where it can be used for road material but decreases its value otherwise. Its total area amounts to a few hundred acres, all in the southeastern part of the county.

**Labette silt loam, cherty phase.**—Labette silt loam, cherty phase, is less expensive than Labette silt loam, gravelly phase, and has the same agricultural usage as the typical soil. It is very similar to the typical soil in surface features, but the presence of the cherty material at irregular intervals, at a depth ranging from 18 to 24 inches, makes this soil a little difficult to handle, especially where erosion is active. The chert fragments, locally called "niggerheads" appear on the surface if the topsoil is allowed to wash away, thereby making cultivation difficult. Many farmers use this soil for orchards and early gardens.

**Labette silt loam, heavy-subsoil phase.**—Labette silt loam, heavy-subsoil phase, is inextensive, only a few small areas being identified in the northwestern corner of the county. It is a little more productive agriculturally than the gravelly phase. It differs from typical Labette silt loam in the presence of a heavy somewhat plastic subsoil. Numerous small bodies of this soil were included with typical Labette silt loam in mapping, as they were too small to separate, and those that were separated are closely associated with the typical soil.

During dry years crops stay green a little longer on this soil than on the typical silt loam, but during wet years they suffer from exces-

sive moisture. Clover and alfalfa do better than on any other soil of the group. The other crops grown are practically the same as those grown on typical Labette silt loam.

**Crawford silt loam.**—Crawford silt loam, the so-called "red land", is highly productive, being one of the strongest and best soils in the county for early crops. It is one of the heaviest producing soils during seasons of abundant moisture. It is a soil that responds to fertilizers, especially to barnyard manure. This soil can be farmed with small work animals and light machinery.

The surface soil is dark reddish-brown or pale reddish-brown silt loam from 8 to 12 inches thick. The subsoil is dark-red smooth and moderately friable silty clay, which extends to a depth ranging from 30 to 50 inches, where it passes into soft marl or hard crystalline limestone. In eroded places the red clay subsoil is exposed, but such spots are too small to be separated on the soil map.

This soil can be readily plowed after rains and does not puddle. It occupies the higher benchlike areas in association with Labette silt loam. Approximately 95 percent of the land is in cultivation, principally to corn, wheat, and kafir, but alfalfa and clover are grown on only a small acreage. During dry years a field in alfalfa shows a striped effect, owing to the fact that the roots of the plants growing above crevices in the underlying limestone grow downward into the crevices and obtain more moisture than is available to plants whose roots grow above the unbroken limestone.

Alfalfa land receives an acre application of about 2 tons of lime. Wheat receives about 100 pounds of bone meal, and many farmers use mixed fertilizers, usually 2-12-2 or 4-20-4 mixtures.<sup>2</sup> The potash, however, is of little or no value.

**Crawford stony silt loam.**—Crawford stony silt loam differs from Crawford silt loam mainly in the stone content of the soil which contains various amounts of limestone fragments and slabs both on the surface and throughout the soil.

This soil occupies 960 acres. It is used principally for pasture, although a few small patches are used for small grains, principally oats.

#### SOILS OF THE BATES GROUP

The soils of the Bates group occupy 30.7 percent of the total area of Woodson County. They occur most extensively in the central, southern, and western parts, in large continuous areas in a northeast-southwest belt several miles wide, extending from the northeastern corner entirely across the county.

The surface relief ranges from smooth or undulating to rolling. Surface drainage is good, and internal drainage ranges from fair to good. Bates stony loam lies on rather rugged relief, and drainage is excessive in places. This soil in most places is shallow, owing partly to erosion. The stone content consists of sandstone fragments. On most of the land in cultivation sheet erosion is active, and some gullying is evident on the steeper slopes.

The surface soils of the Bates soils are dark grayish yellow or grayish brown, and they are dominantly sandy in texture. They

<sup>2</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

have a moderately low content of organic matter, are lighter in color than the other upland soils, and have an acid reaction. The subsoils are stiff sandy clays and are rather heavy, but they are brittle and allow water to percolate readily. In all soils of this group the parent sandstone material lies at a depth ranging from a few inches to about 40 inches below the surface.

Most of these soils can be plowed after rains without the formation of clods or puddling. Most of them are shallow and lack uniformity in profile characteristics. They respond readily to manure or commercial fertilizers.

Although the subsoils are rather heavy, brittle, stiff, sandy clays, they are not plastic or waxy but are slick and sticky when wet. In many places the finer clay particles have concentrated in the subsoil, but such occurrences are small in area and are seemingly due to a low percentage of salts in the parent rocks. The underlying shales are gypsiferous.

The soils of this group greatly influence the agriculture in the central and southwestern parts of the county, most of the pasture acreage, which includes about 150,000 acres in the whole county, being on these soils. Bates very fine sandy loam and Bates loam are practically the only soils of the group used for crop production. Corn, oats, cane (sorgo), and kafir are the principal crops grown.

These soils are used principally for livestock ranches, small areas only being cultivated, mainly for gardens and forage crops. The sandy character of the soils causes them to warm up early in the spring, and most crops start growth earlier than those grown on the heavier soils.

**Bates loam.**—Bates loam is distributed in a few small areas along the southern boundary of the county, the total area covering only a few hundred acres.

The surface soil is dark-brown light-textured loam, normally extending to a depth of about 8 inches. It is underlain by clay loam or sandy clay loam which, in most places, is brown, but it is reddish brown on slopes where drainage, owing to rapid run-off, is more thorough than typical. At a depth of somewhat less than 3 feet, the underlying soft sandstone and sandy shale, which are disintegrated at the top, are reached.

On account of the small areas in which the soil occurs, it must be used in the same fields with other soils, the kinds of crops grown being determined by the character of the other soils or by some other conditions.

**Bates very fine sandy loam.**—Bates very fine sandy loam, locally called sandstone soil, is the most productive soil in this group, and when handled with care it produces fairly well. In years of high rainfall it will produce good yields of corn and kafir. As in all the Bates soils, this soil is low in organic matter, but it is almost stone free and can be built up to fairly high productivity by the addition of organic matter. Light machinery and small work animals can be used in farming the land.

The surface soil consists of a 5- to 8-inch layer of grayish-yellow or pale yellowish-brown very fine sandy loam. The subsoil is yellowish-gray sticky sandy clay which continues to a depth ranging from 30 to 40 inches, passing below into soft decomposed sandstone. Small

eroded or gullied spots, exposing the heavy sandy clay subsoil, occur in places but are all too small to be shown on the soil map. Deep erosion has a tendency to bring small sandstone fragments to the surface.

Bates very fine sandy loam, together with Bates loam, occurs in small patches on the lower slopes, adjoining Parsons silt loam. A typically developed area is 3 miles south of Yates Center.

About 25 percent of the land is in cultivation to kafir, wheat, and corn. The kind of crop grown differs from year to year, depending on economic conditions. In years of low grain prices, such crops as sorgo or kafir, to be cut for forage, are grown. The soil responds readily to commercial fertilizers, especially those high in nitrates and phosphates.

**Bates fine sandy loam, shallow phase.**—Bates fine sandy loam, shallow phase, is not very productive. The growing of hay and pasture are the principal uses for this soil, although a little corn, kafir, and sorgo are sometimes grown. It is a soil that responds fairly well to the use of fertilizers, especially manure. It erodes easily and is in general very spotted, owing to erosion, the eroded places being hard to prepare for a seed bed. Light machinery and small work animals can be used in farming this land.

The surface soil is yellowish-brown or grayish-yellow fine sandy loam from 5 to 8 inches thick. The subsoil is yellowish-brown sandy clay which continues to a depth ranging from 18 to 30 inches, where it passes into the rotten gypsiferous sandstone.

Bates fine sandy loam, shallow phase, occurs in widely scattered areas. Approximately 75 percent of the land is used for pasture, as it produces a wide variety of tall grasses, together with weeds and broomsedge. Kafir and sorgo are grown to some extent on the cultivated areas, but yields are low. Hay yields about three-fourths ton an acre. Some lespedeza is grown in the pastures.

**Bates stony loam.**—Bates stony loam differs from Bates fine sandy loam, shallow phase, mainly in texture of the surface soil, in the presence of stones scattered throughout the surface soil, and in occurrence on rolling relief. The surface soil contains various quantities of sandstone and shale fragments, which may occur as loose stones on the surface or as outcrops of the bedrock. The stones in the surface soil prevent the use of mowing machines.

This soil occupies 68.8 square miles in Woodson County and is used exclusively as pasture. The subsoil is much heavier than that in any other member of the Bates series. In places it approaches a claypan and contains various amounts of soluble sulphates which have a marked influence on the vegetation. Slick spots occur in many places, on which short grasses only grow. Weeds, except cactus, will not grow on the slick spots. The subsoil lies within a few inches of the surface.

#### SOILS OF THE VERDIGRIS GROUP

The soils of the Verdigris group include all the soils developed from alluvium, the most productive soils of the county. They are Verdigris very fine sandy loam, Verdigris silt loam, Verdigris silty clay loam, Osage silty clay loam, Osage clay, Lightning very fine

sandy loam, and Lightning silty clay loam. They occur along Neosho and Verdigris Rivers and their larger tributaries, and cover 9.3 percent of the total area of the county.

All the soils of this group are characterized by smooth surface relief. Natural drainage is good in the Verdigris soils and fair or poor in the Lightning and Osage soils. The surface soils of members of the group range from very fine sandy loam to clay in texture and from dark brown to black in color. All the soils near the stream channels have smooth uniform textures, but those farther from the streamways have heavy textures and are mottled with red, yellow, and gray in the subsoils. The subsoils are rather heavy but are brittle and readily penetrated by water. The fine texture of the surface soils causes them to run together when wet, and if not plowed under proper moisture conditions they break into large clods, some of which are broken with difficulty. These soils are rather low in organic matter but, taken as a whole, contain more organic matter than most of the upland soils. They range from neutral to acid in reaction, the sandy members being moderately acid and the heavier ones neutral.

The heavy texture of the soils and their occurrence in nearly flat areas, together with the presence of ground water at a comparatively slight depth, tend to the maintenance of a good supply of moisture. With the exception of Verdigris fine sandy loam and Verdigris silt loam, these soils warm up slowly in the spring, owing to their heavy textures and to the fact that they do not drain so readily as soils on rolling surface relief. They receive fresh plant nutrients from inwash from the surrounding uplands and from the flood waters. Their slow drainage protects them from rapid leaching. The subsoils of members of the group, although rather heavy and brittle, are not plastic and waxy but are smooth and sticky when wet and hard and compact when dry.

The soils of this group produce higher acre yields than do the upland soils. Corn and alfalfa are the principal crops, and wheat and clover are grown to some extent. These crops are grown indiscriminately on the different soils, wherever the relief is favorable, but Verdigris very fine sandy loam, Verdigris silt loam, and Verdigris silty clay loam are the best soils in the county for the production of corn and alfalfa. Verdigris very fine sandy loam, because of its texture and good drainage, is an excellent trucking soil for growing potatoes, tomatoes, mangoes, and all small garden crops. Many of the better orchards are on this soil, and the yields of all crops are much higher. The soils of this group are well distributed throughout the county and have a marked influence on the productiveness of the farms on which they occur. The fact that they are flooded occasionally increases the risk of crop damage, but the high yields far outweigh the menace of damage from floods.

**Verdigris very fine sandy loam.**—Verdigris very fine sandy loam ranks high as an agricultural soil, being one of the strongest and best soils in the county for alfalfa and corn. This is a soil that retains its productivity for a long time, as it is rejuvenated by floods and inwash from the uplands. As in all the Verdigris soils, the subsoil is rich in lime. Small work animals and light machinery can be used in farming this land.

The 7- to 12-inch surface soil is grayish-brown or yellowish-brown very fine sandy loam, and the subsoil is brown or yellowish-brown heavy sandy clay loam which extends to a depth of about 40 inches, where it passes either into the underlying bedrock or yellowish-gray alluvial material. The texture is not uniform but, like many soils developed from alluvium, is variable. On account of the sandy texture of the surface soil, it plows easily and remains mellow even when wet.

Verdigris very fine sandy loam occurs along Sandy Creek in the southwestern part of the county, and in several places along the upper part of Owl Creek. Approximately 95 percent of its area is in cultivation, principally to corn and alfalfa. Small patches of kafir, clover, potatoes, tomatoes, and other crops are grown. Corn yields range from 30 to 50 bushels an acre, alfalfa from 2 to 3 tons, and most other crops correspondingly high. Little or no fertilizer is used, but some lime is used in growing alfalfa.

**Verdigris silt loam.**—Verdigris silt loam occupies 10,432 acres in the valleys of the larger streams. It is a very productive soil, especially for corn and alfalfa. It is a little more productive, perhaps, than Verdigris very fine sandy loam in the drier years, but it is not quite so productive in years of heavy rainfall.

Verdigris silt loam differs from Verdigris very fine sandy loam principally in the texture of the surface layer. Farming operations are practically the same as on the very fine sandy loam, and in many places the same crops are grown. The more sandy soils seem to warm up and drain out a little better, but the heavier soils seem to retain moisture a little better during the drier part of the season. Verdigris silt loam has a tendency to produce better late-yielding crops, and the difference in the yield of the third cutting of alfalfa is marked in favor of the silt loam. However, the seasonal rainfall seems to be the controlling factor in yields. Yields of early maturing crops are not so good on the silt loam as on the very fine sandy loam, but the reverse is true with late-maturing crops.

**Verdigris silty clay loam.**—Verdigris silty clay loam occurs principally along Verdigris River, but small areas lie along Neosho River north and northwest of Neosho Falls, and along Turkey Creek. This soil differs from the other Verdigris soils described in its heavier texture and in the presence of slick spots. Practically the same crops are grown as on the previously described soils, and in addition a small acreage is in wheat. If artificially drained, excellent yields of corn, alfalfa, and wheat are obtained, but yields are less certain than on the lighter textured members of the series. The soil is slow to warm up in the spring, does not drain out so readily, and crop yields are not so high. Cultivation is not so effective on account of the imperfect drainage, the crops being usually very weedy. This land is a little harder to farm and yields are a little less than on the lighter textured soils.

**Osage silty clay loam.**—Osage silty clay loam occurs along Neosho River and Owl and South Owl Creeks a short distance from the main streams. It lies in low poorly drained situations, is dark grayish brown or black in the surface soil, and supports a natural vegetation of sloughgrasses and water-loving shrubs. The subsoil begins as dark grayish-brown silty clay mottled with gray, rust-yellow, and

brown stains. It is rather heavy and in places is cemented with iron rust. It is not compact, but fairly friable, considering its heavy texture. At a depth ranging from 20 to 50 inches this layer is underlain by old alluvium or by bedrock.

About 60 percent of the land is under cultivation, principally to clover, alfalfa, corn, and wheat. Where the areas are drained it is fairly productive, acre yields of corn ranging from 20 to 40 bushels, wheat from 10 to 25 bushels, and alfalfa and clover about 1½ tons each. This soil requires heavy machinery and strong work animals for cultivation. Crops grow slowly in the spring, and harmful effects are noticed where the soil is submerged by water for a long time.

**Osage clay.**—Osage clay differs from Osage silty clay loam principally in texture and in being even less poorly drained. In favorable years, yields are about the same as on Osage silty clay loam.

**Lightning silty clay loam.**—Lightning silty clay loam occurs in very small areas of very poorly drained soil, principally along the lower part of Owl Creek. It is cultivated principally to wheat or is left in prairie grasses. This soil is the least productive alluvial soil.

The surface soil of Lightning silty clay loam is light grayish-brown or yellowish-brown silty clay loam, the lower part containing a distinct gray layer. The subsoil is light yellowish-gray material cemented with iron and splotched and stained with various organic infiltrations.

Crop yields are comparatively poor. Hay is the best crop, producing about 1 ton an acre. Corn yields range from 7 to 15 bushels an acre and wheat from 3 to 5 bushels. This soil responds well to applications of barnyard manure or commercial fertilizers. Artificial drainage is necessary for profitable production on this soil, and yields are greatly increased where the drainage is improved.

**Lightning very fine sandy loam.**—Lightning very fine sandy loam differs from Lightning silty clay loam in texture only. It is of small extent, and most of the areas are too small to be farmed separately. Yields, however, are a little better on this soil and in places approach those obtained on Verdigris very fine sandy loam. Agricultural practices are practically the same as on Lightning silty clay loam.

#### AGRICULTURAL METHODS AND MANAGEMENT

The productivity of a soil can be increased or diminished by its treatment. Building up and maintaining productivity to a high level is an achievement toward which every farmer should strive. The management of the farm should be as intelligently and carefully planned as that of any other business, in which every process must be understood and regulated in order to obtain the most profitable results. The farmer's success depends largely on his knowledge and treatment of the soils, and different soils present different problems as to treatment and kinds of crops to be grown. The requirements of the soils may differ greatly, and both their chemical and physical condition must be understood. The requirements of plants also differ, and the farmer should plant those crops whose needs can best be satisfied by his soil.

The system of farming that has been followed in Woodson County for the last 50 years has not maintained the fertility of the soil, as

the soils now are not so productive as were the virgin soils. The soils are somewhat lacking in available plant food, but their most serious need is organic matter. Many of them have heavy claypan subsoils and are not adapted to tile drainage, but improving the surface drainage of such soils by properly constructed ditches would be of much value. On some first-bottom soils, such as those of the Lightning series, tile drainage may greatly improve the land, but, owing to the excessive cost, not much has been done in recent years.

Owing to excessive rainfall in this section, considerable soil erosion is taking place, even on soils lying on very gentle slopes. This is especially noticeable where the crop rows run in the same direction as the slope rather than across the direction of slope. A highly recommended precaution against soil erosion may be provided by the use of broad terraces, as such terraces allow the water to be slowly removed, thus reducing surface erosion and allowing a greater quantity of the water to soak into the soil. Where terraces are not used, contour planting of row crops is practical if the slopes are not too irregular. Other precautions against soil erosion are keeping the land covered with a close-growing crop most of the year, or a cropping system which includes some small grain or soybeans in close rows and a sod legume like clover or alfalfa, in addition to the cultivated crops, such as corn and sorghum. This will be still more effective if the row crops are planted approximately on the contour so as to prevent rapid run-off when the land is under cultivation.

The productivity of the Woodson County soils can be greatly improved by growing alfalfa, sweetclover, red clover, and soybeans. These legumes will aid in supplying the needed nitrogen and organic matter which is deficient in the soils. Under a carefully worked out cropping system approximately one-fourth of the acreage should be planted to legumes which should be fed to livestock and the manure returned to the soil. Sweetclover and red clover are being experimented with on the heavy claypan soils, such as the Parsons and Cherokee. Lime is drilled in with the inoculated seed at a rate of 200 or more pounds an acre, and the results are very favorable. Soybeans and cowpeas seem to thrive, and they improve the soils to some extent without the use of lime. The hay of these annual legumes is equal in nutritive value to that of alfalfa or clover. The popular varieties of soybeans are Peking, A.K., Virginia, and Laredo. The Virginia is the best for hay on the claypan soils, but the Laredo, a late variety, is recommended for the other upland soils. A.K. is the best soybean for seed purposes. Descriptions of outstanding varieties of soybeans are given in the United States Department of Agriculture Farmers' Bulletin 1520<sup>3</sup> and Bulletin 249 of the Kansas Agricultural Experiment Station, which may be used to advantage when considering the growing of this crop. The popular varieties of cowpeas are Whippoorwill, Clay, and New Era.

The use of commercial fertilizers is well established. They are used principally on the small-grain crops and the legumes, particularly alfalfa. Lime and phosphatic fertilizers are necessary for the

<sup>3</sup> MORSE, W. J. SOYBEANS: CULTURE AND VARIETIES. U.S. Dept. Agr. Farmers' Bull. 1520, 33 pp., illus. 1927.

ZAHNLEY, J. W. SOYBEAN PRODUCTION IN KANSAS. Kans. Agr. Expt. Sta. Bull. 249. 31 pp., illus. 1930.

successful production of alfalfa on all types of upland soils in the county, especially the soils of the claypan group. The soils are low in content of phosphorus, and the use of phosphate fertilizers on all crops, especially wheat, has given good increases. The fertilizers more commonly used are bone meal, superphosphate, and rock phosphate. Finely ground raw rock phosphate has given good increases on the Cherokee and Parsons soils. A limited quantity of nitrogenous material may be used in mixed fertilizers, but in general the nitrates are most economically supplied by growing inoculated leguminous crops. Ammonium sulphate or sodium nitrate may be used to good advantage on lawns and pastures. It can also sometimes be used to advantage on late-prepared wheatland where nitrification has been too low to supply sufficient nitrates for the wheat crop. Ground plowed during July generally produces from 2 to 4 bushels more wheat an acre, owing to a larger amount of available nitrogen than ground plowed in August. Some potash has been used experimentally in mixed fertilizers in this section, but the results obtained indicate that its use is not profitable.

Very little systematic rotation of crops is practiced. The importance of a leguminous crop is generally recognized, and its use is valuable in diversified farming. A practical rotation used by many farmers is a 5-year rotation consisting of (1) sorgo or kafir, (2) oats and sweetclover (the sweetclover to be plowed under in the spring), (3) corn, (4) flax, and (5) wheat. This rotation may be varied from time to time in order to meet certain needs or economic conditions. It is sometimes advisable to grow flax as a nurse crop with sweetclover or alfalfa. Soybeans may be grown for hay or seed between the corn and flax crops in the rotation. All the better rotations include a legume. The size and kind of farms govern the rotation system and the kind of fertilizers used.

At the experiment substations at Columbus, Fort Scott, Parsons, and Rest, alfalfa, corn, and wheat were planted in plots of Cherokee, Summit, Parsons, and Labette soils, respectively. All crops were much better on the Summit than on the Cherokee soils, but where fertilizers were used the crops were more uniform. The response to fertilizers was much greater on the Cherokee soils, but the total crop production was greater on the Summit soils.

The data in table 6, taken from the reports of the southeastern Kansas experiment fields, show the value of different fertilizer treatments on alfalfa on five of the more extensive soils of this section.

TABLE 6.—*Summary of the increase in yield of alfalfa on southeastern Kansas experiment fields, due to different fertilizer treatments*

Treatment	Cherokee silt loam at Colum- bus	Summit silty clay loam at Fort Scott	Oswego silt loam <sup>1</sup> at Moran	Parsons silt loam at Parsons	Labette silt loam at Rest
	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>	<i>Tons</i>
No treatment.....	0.96	1.69	1.60	1.19	2.21
Lime.....	2.26	1.77	2.62	2.28	2.50
Increase attributable to lime.....	1.30	.08	1.02	1.09	.29
Lime.....	2.26	1.77	-----	2.28	2.50
Lime and superphosphate.....	2.75	2.14	-----	2.99	3.32
Increase attributable to superphosphate.....	.49	.37	-----	.71	.82
Lime and manure.....	3.06	2.29	3.25	3.12	3.35
Lime, manure, and superphosphate.....	* 3.22	3.36	3.97	3.45	4.11
Increase attributable to superphosphate.....	.16	1.07	.72	.33	.76
Lime.....	2.26	1.77	2.62	2.28	2.50
Lime and manure.....	3.06	2.29	3.25	3.12	3.35
Increase attributable to manure.....	.80	.52	.63	.84	.85
Lime and superphosphate.....	2.75	2.14	-----	2.99	3.32
Lime, manure, and superphosphate.....	* 3.22	3.36	-----	3.45	4.11
Increase attributable to manure.....	.47	1.22	-----	.46	.79
No treatment.....	-----	1.69	1.60	1.19	2.21
Manure.....	-----	2.22	2.05	2.15	2.65
Increase attributable to manure.....	-----	.53	.45	.96	.44
Average increase from superphosphate.....	.32	.72	.72	.52	.79
Average increase from manure.....	.63	.76	.54	.75	.69

<sup>1</sup> Mapped as Woodson silt loam in Woodson County, Kans.<sup>2</sup> Yields from lime, manure, and rock phosphate plot used because of apparent soil variation on lime, manure, and superphosphate plot.

About 60 percent of the land in Woodson County is in pasture and waste land. Most of the farm pastures are used for all the farm livestock and are in poor condition. The first step toward improving the pastures is to eradicate the weeds and brush. In most pastures this can be done by mowing at the proper time. This is because all perennial plants use reserve food to start growth in the spring. This supply is drawn on until the plant has made enough leafy growth to manufacture food in sufficient quantity to supply the growing needs of the plant, after which the reserve supply is gradually restored. Eradication of weeds is most effective if done about the time food reserves are lowest in the plant, as it is weakest at this time and has the least power of resistance.

The time that plants can be most effectively eradicated differs with different plants, also in different parts of the State, according to altitude and latitude. With most plants on which experimental work has been done the most effective time of eradication is about the time flower buds first appear. Some of the most common perennial weeds, such as ironweed and vervain, should be mowed about the first of June. Stiff-leaved goldenrod should be mowed about the middle of July. Ragweed and broomweed can be most effectively mowed about the middle of August. The most effective time of cut-

ting buckbrush is the early part of May, whereas the time that sumac can be killed most easily is about a month later. If the clippings are made a month earlier or later than this date, they have little or no effect on killing the plants.<sup>4</sup>

After the weeds have been eradicated, it is advisable to reseed the pasture. It is unprofitable to sow grasses or legumes without some preparation of the soil, and a light disking is usually sufficient when the character of the land will allow. The seeding should be done in the early spring. A mixture including 4 pounds of redtop, 8 pounds of orchard grass, 6 pounds of meadow fescue, and 2 pounds of Korean lespedeza is well suited for sowing in most of the run-down pastures and will seed 1 acre. After a new stand of grass is obtained it must be properly grazed or it will soon be in the same condition as before reseeding. One of the most important precautions is to avoid overgrazing, especially early in the season, as the forage plants must get a good start before livestock are turned on the pasture. Each mature cow or horse should have  $3\frac{1}{4}$  or more acres of pasture, depending on the quality of the land.

It is good practice to supply temporary pasture for early spring and late fall grazing, and winter rye is well suited to this purpose. It should be sown in August or early September, and in most years will furnish feed from about the middle of October until the latter part of December. It will also furnish pasture early in March and can be used until May, when the permanent pasture can be used without injury. The rye can then be turned under in time to plant sorghums or other summer crops. Sweetclover, where it can be grown, makes an excellent supplementary pasture for early spring and also during dry months when grass does not make much growth.

### SOILS AND THEIR INTERPRETATION

Woodson County lies in the prairie plains region of southeastern Kansas, where the surface features and an adequate supply of moisture favor a grass vegetation over the smooth upland. Where the surface features have become modified by the cycle of erosion the slopes support a tree growth. The natural vegetation at the time of settlement of this region by white man was grass over the comparatively smooth uplands and forest along the deeper stream valleys.

The soils have developed under the influence of a grass vegetation and a rainfall heavy enough to keep the soil moist or saturated part of the year, giving rise to large quantities of organic matter, but the high seasonal temperature during late summer has caused the decomposition of the greater part of the organic matter, and the part remaining and incorporated in the soil, through the decay of grass roots, imparts to the prairie soils their characteristic dark-gray color. With an annual rainfall of a little less than 40 inches and a mean annual temperature of about 56° F., the soils are not very dark, but are dark gray. Local differences in surface relief and parent material have caused the development of the different soils. The parent material, as well as the relief and climate, has had a great influence on the development of the different soils. Surface relief has caused

<sup>4</sup>ALDOUS, A. E., and ZAHNLEY, J. W. TAME PASTURES IN KANSAS. Kans. Agr. Expt. Sta. Bull 253, 39 pp., illus. 1931.

many of the minor differences, as the climate and vegetation are much the same over the county.

The differences most apparent are those due to the parent formations, as limestone, sandstone, and shale, together with gypsum-bearing shale. The wide differences of relief and the consequent effect on drainage obviously influence soil character very greatly.

For convenience of description, the soils have been grouped, according to common characteristics, as follows: (1) Cherokee, Parsons, and Woodson soils; (2) Summit soils; (3) Labette and Crawford soils; (4) Bates soils; and (5) Verdigris, Osage, and Lightning soils.

The most extensive is the claypan group, which includes the Cherokee, Parsons, and Woodson silt loams. These soils occupy nearly half the total area of the county and are well distributed. The Cherokee soils occur on the more level areas, and the Parsons and Woodson soils occupy the more undulating or sloping areas. These soils are very closely associated, and, as their greatest difference is in the surface soil, their separation in the field is somewhat difficult, especially under the various moisture conditions. The differences in characteristics are due mainly to differences in surface relief.

In a pit in the southwest corner of sec. 20, T. 25 S., R. 16 E., an area of Parsons silt loam showed the following profile:

- A<sub>1</sub>. 0 to 5 inches, grayish-brown structureless or faintly laminated porous silt loam. The color is uniform, except that the material contains various amounts of organic matter and a few rust-colored specks which blend with the surrounding matrix.
- A<sub>2</sub>. 5 to 14 inches, grayish-brown porous laminated silt loam which is a little lighter in color than the material in the layer above. The material in this layer is slightly more acid than that in the layer above.
- A<sub>3</sub>. 14 to 15 inches, a thin transitional brownish-gray layer merging with the claypan material. This material is made up of small angular particles, identical in shape with those in the underlying claypan layer, all coated with gray silty material. The insides of these particles are identical in texture, color, and consistence with the particles in the claypan, and they seem to consist of particles formerly constituting the upper part of the claypan, later separated from it by the formation of the gray coatings around the particles. Tongues of the gray silty material extend into these particles along joint planes and downward into the claypan along similar planes. The lower half inch contains more clay particles than the upper, and the gray silt material gives way to a prismatic, columnarlike clay.
- B<sub>1</sub>. 15 to 24 inches, drab or reddish-brown extremely dense clay which breaks into irregular sharp-cornered semicubical clods several inches in diameter. The structure particles lie close together and, when moist, adhere to one another so firmly that they can scarcely be separated. A lump, however, when dried or sliced shows definite structure particles. The outsides of the structure particles are coated with dark bluish-gray colloidal material. Many particles have red and yellow or rust-brown centers, and black streaks are common, giving the whole mass a rather mottled appearance. The material on drying breaks down into fine fragmental particles with sharp angular corners. The material, as a whole, appears rather dark reddish brown or drab. On drying, thin rust-brown stains are present on the soil particles. This is the layer of maximum density.
- B<sub>2</sub>. 24 to 44 inches, grayish-brown or drab dense clay, similar to the material in the layer above but not quite so dense and a shade or so lighter in color. The red, rust-brown, and black specks become lighter with depth and gradually change to yellow and gray. The lower few inches of this layer contain gypsum crystals, lying near the top of the partly weathered shales.
- C. 44 inches +, bluish-gray partly weathered soft gypsiferous platy shale which becomes harder with depth.

Studies made of Parsons silt loam at different places and under different moisture conditions differed somewhat from the profile described. Great variations were noticed within short distances of one another in the thicknesses of the different horizons. The color of the B horizon ranges from almost red to yellow or dark drab within short distances, accompanying local differences in relief. The essential features of this soil are very uniform, and minor variations are too numerous to show on the soil map. Many slick-spotlike areas occur associated with the typical soil. The surface soil on these spots is very thin, and the subsoil, or B horizon, is very dense and almost black. The claypan layer cracks vertically into columnar forms, the top of each column is rounded and coated with gray silty material, and the same material coats the columns. At a depth ranging from 18 to 30 inches below the surface, this soil is thoroughly impregnated with gypsum, and traces of sodium sulphate are present.

Cherokee silt loam differs from Parsons silt loam in degree of development, and it is slightly more acid in the upper layers and more dense in the lower layers. Cherokee silt loam has a lighter and more laminated  $A_2$  horizon, in which the granules present in this horizon of the Parsons soil are almost entirely absent, and the whole mass is a solid porous almost white floury silt. The  $B_1$  horizon is a claypan similar to that of the Parsons soil, in most places being a little darker in color and consisting of very dense colloidal clay. The  $B_2$  horizon is very similar to that of the Parsons, except no gypsum crystals are present. Tests with barium chloride showed the sulphate radical present in this horizon. The C horizon is very similar to that of the Parsons, but gypsum is not so abundant.

Woodson silt loam differs from Parsons silt loam in having a much darker and slightly heavier surface layer. The surface layer is somewhat granular, the granules being very small at the surface and gradually increasing in size with depth. The  $A_2$  horizon merges with the  $A_1$  horizon gradually, and in places the granules in the  $A_2$  horizon have a sprinkling of gray. The B horizon merges with the  $A_2$  horizon gradually and is not so compact as the corresponding layer in the Parsons soil, but is a dense clay. The columnar structure is not so pronounced, and grass roots penetrate all horizons. On drying, the crevices between the clods show an efflorescence of gypsum. The lower part of the B horizon contains an abundance of gypsum crystals and some in the unassimilated form.

Table 7 gives the results of pH determinations of Woodson silt loam and Parsons silt loam at different depths, as made in the laboratories of the Bureau of Chemistry and Soils by the hydrogen-electrode method.

TABLE 7.—*pH determinations of two soils from Woodson County, Kans.*

Soil type and sample no.	Depth	pH	Soil type and sample no.	Depth	pH
Woodson silt loam:	<i>Inches</i>		Parsons silt loam:	<i>Inches</i>	
382704.....	0- 7	5. 27	382712.....	0- 5	5. 27
382705.....	7-14	6. 75	382713.....	5-10	5. 60
382706.....	14-30	7. 57	382714.....	10-16	6. 35
382707.....	30-36	7. 25	382715.....	16-30	7. 59
382708.....	36-44	7. 30	382716.....	30-40	7. 75
			382717.....	40-60+	7. 67

The Summit soils, comprising the second group, have dark-colored surface soils and heavy friable subsoils. They have developed from calcareous and gypsiferous shales and occur in isolated areas in all parts of the county, more especially in the central part, on the lower slopes and around stream heads. They are fairly well drained.

In a pit one-fourth mile west of the southeast corner of sec. 7, T. 25 S., R. 15 E., an area of Summit silty clay loam showed the following profile:

- A<sub>1</sub>. 0 to 2 inches, very dark grayish-brown or black silty clay loam which is faintly laminated or slightly granular and consists of a dense sod containing much organic matter.
- A<sub>2</sub>. 2 to 7 inches, granular silty clay loam, in which the granules are heavily coated with organic matter and have semirounded corners. A slight sprinkling of gray was noticed on the granules when dry. Ferruginous pellets, the peripheries of which are black and the centers brown, are present. The soil appears brown when crushed but is almost black on a broken face.
- A<sub>3</sub>. 7 to 16 inches, material similar to that in the horizon above, except the granules seem to be a little firmer, the organic coating is thinner, and root hairs seem to follow the cleavage planes between the structure particles. The material contains less organic matter and is more dense.
- B<sub>1</sub>. 16 to 32 inches, dark-brown or drab granular silty clay, in which the granules are lighter in color and a little firmer than in the layer above. The organic coatings, which give the dark color, become thinner with depth. The insides of many particles are red or rust brown, and the outsides are grayish red. The clay content gradually increases with depth.
- B<sub>2</sub>. 32 to 50 inches, drab or yellowish-brown clay, in which the structure particles are small and sharply angular. This layer is moderately compact and contains ferruginous pellets from one-sixteenth to one-eighth inch in diameter. The lower part of this layer has more or less columnar breakage and contains some siliceously coated lime nodules and gypsum crystals.
- C. 50 inches +, bluish-gray partly decomposed gypsiferous shales.

In studies made of the Summit soils under different moisture and cultural conditions and at different places some interesting features were noticed that did not appear in the profile described. Cultivation tends to make the soil lighter gray in color, owing to the loss of organic matter, and heavier in texture, owing to the topsoil cracking and the organic part washing into the cracks, which gives the solum in excavations a latticelike appearance. Siliceously coated lime nodules are present at irregular intervals, and the material in these places is a little darker and not so thoroughly weathered. Calcium sulphate and calcium carbonate are present in different amounts in the lower part of the subsoil. The surface soil is slightly acid, and the subsoil is neutral or alkaline.

Soils of the third group include members of the Labette and Crawford series. These soils are essentially identical in character and stage of development with the Summit soils.

The fourth group includes soils of the Bates series. These soils closely resemble one another in most characteristics, except in texture of the surface soil and depth of weathering. Areas of the Bates soils occur in the western part of the county and southeast of Toronto. Following is a profile description of Bates very fine sandy loam as observed in a pit one-half mile north of the southwest corner of sec. 2, T. 26 S., R. 15 E.:

- A<sub>1</sub>. 0 to 2 inches, dark grayish-brown very fine sandy loam forming a porous mulch.
- A<sub>2</sub>. 2 to 7 inches, dark grayish-brown porous imperfectly granular loam which shows evidence of worm action. The color is almost uniform, but the crushed granules are a little lighter.
- A<sub>3</sub>. 7 to 18 inches, dark grayish-brown sandy loam which is slightly lighter than in the layer above. It is very faintly granular, the granules seeming to be due to worm action.
- B<sub>1</sub>. 18 to 30 inches, light rust-brown sandy clay loam containing small cube-shaped particles, the centers of which appear to be lighter rust brown and the outer layers reddish brown, with yellowish-gray material between the particles. The colors, however, are so blended and granulation is so imperfectly developed that the color distribution cannot be determined accurately. The material crushes yellowish brown, indicating that the rust shades dominate.
- B<sub>2</sub>. 30 to 40 inches, moderately compact coarsely granular yellowish-brown clay loam. The insides of structure particles are red, and the outsides are thickly coated with grayish brown. The material contains sufficient clay to smear between the fingers and when crushed is mottled red, gray, and brown, the gray and brown dominating.
- B<sub>3</sub>. 40 to 60 inches, gray and rust-brown silty clay containing soft black and rust-brown pellets. This layer grades into the raw unweathered very fine sandy gypsiferous shale.

### SUMMARY

Woodson County is in southeastern Kansas. It includes 503 square miles, or 321,920 acres. Physiographically it is part of a plain which has been slightly dissected. The greater part of the land is flat or undulating, with a few low winding ridges.

In 1930 the county had a population of 8,526, all classed as rural. Yates Center, the county seat and largest town, had a population of 2,013. Most of the people are of native-white parentage.

The climate is characterized by wide seasonal variations. The greater part of the annual rainfall comes during the growing season. Hot winds in late summer may damage growing crops.

Prairie hay, wheat, oats, sorghums, alfalfa, and soybeans are the most important crops grown.

About 60 percent of the land is tillable. The soils have been placed in five groups, according to common characteristics and crop adaptation. The groups are the Parsons, the Summit, the Labette, the Bates, and the Verdigris. Group 1 occupies 40.9 percent of the county; group 2, 11.4 percent; group 3, 7.7 percent; group 4, 30.7 percent; and group 5, 9.3 percent.

The soils in group 1 have lighter colored surface layers and dense heavy claypan subsoils. The heavy claypan subsoils retard drainage, and plant roots can neither penetrate the claypan nor reach the moisture below. For this and climatic reasons these soils are better suited to short-rooted crops, such as wheat and sorghums. Corn is grown to some extent, but yields are uncertain. The ability of the sorghums to withstand drought makes them more successful. Cherokee silt loam is probably the least productive of these soils. It occurs on nearly flat areas. Woodson silt loam and Parsons silt loam have darker surface layers and contain more organic matter. These soils occur on gentle slopes and are better drained. The parent shales of these soils are gypsiferous.

The soils of group 2 have dark-colored surface layers, rich in organic matter, and have moderately heavy subsoils. Deep-rooted

crops, as corn, produce well on these soils. Wheat and other grains do well, but the need for corn is so great that these soils are planted mainly to corn.

Soils of the third group have dark-brown or dark reddish-brown surface layers and reddish-brown silty clay subsoils. These soils are well drained and are cropped to corn, wheat, alfalfa, and sorghums.

Soils of the fourth group, or the Bates soils, have grayish-brown sandy surface soils and yellowish-gray sandy clay subsoils. The physical condition is good and the chemical condition poor. Corn and the grain sorghums are the principal cultivated crops, and prairie hay is common. The greater part of the pasture land consists of these soils.

The soils of group 5, or alluvial soils, are the most productive in the county, but crop harvest is somewhat uncertain, because of overflows. Alfalfa, corn, wheat, clover, and oats are the chief crops.

Fertilizers are in common use, principally on wheat and alfalfa. Fertilizers high in phosphates give the best results. Liming and inoculation are necessary for the successful production of alfalfa and sweetclover.



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